ENGR 202/4 sections SS and R - WINTER 2012

Sustainable Development and Environmental Stewardship

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FINAL EXAM

April 25, 2012

Time 19:00-22:00

CLOSED BOOK

Total: 60 Marks

Problem # 1 (5 marks)

Define or explain the following terminology:

--- CAA

--- TDS

--- NOAEL

--- IPCC

--- MCL

Problem # 2 (5 marks)

a. Name two major contaminants for ground waters and their sources? (3 marks)

b. Give two benefits of designing a product to fit into a life cycle? (2 marks)

Problem #3 (6 marks)

a. What is a pathogen (3 marks)

b. Define MCL for drinking water (3 marks)

Problem # 4 (2 marks)

Among the many toxic metals the quantitative analysis on mercury is one of the most widely studied. Give me some reasons why mercury has received attention in scientific studies?

(2 marks)

Problem #5 (6 marks)

a) What is the difference between Potency Factor and Chronic Daily Intake for a carcinogenic chemical? (3 marks)

b) Explain some of the "uncertainties" in assessing risk for non-carcinogens? (3 marks)

Problem # 6 (5 marks)

a) What are the 3 major factors affecting increase in CO_2 emissions? (3 marks)

b) What is bioaccumulation and give an example (2 marks)

Problem # 7 (7 marks)

a) What is Hazard Quotient? (3 marks)

b) Name 4 steps of risk assessment (4 marks)

Problem # 8 (6 marks)

The chronic daily intake of a carcinogenic chemical is equal to the value of 3µg/da from the oral total dose and 16µg/da for the adult male weighing 70 kg. Using the potency factor values from Table 14.3, find his incremental lifetime cancer risk if the chemical of concern is a) arsenic b) Trichloroethylene (TCE). How do these risks compare to the EPA guideline of $1x\ 10^{-6}$? Give your answer as a ratio of multiple (such as 150 times greater, or smaller, than 10^{-6})

Problem # 9 (6 marks)

A well has 2.0 mg/L of zinc, 2.5 mg/L formaldehyde and 70 µg/L of chloroform. Would there be any concern about carcinogenic health effects of using this water for drinking purposes?

$HI=\Sigma HQ$, $HQ = ADD/RfD$

Problem # 10 (6 marks)

A contaminated site has 100mg/kg of chloroform. Is the cancer risk low enough for the site to be used as a playground for children according to the EPA guideline of $1x10^{-6}$? Assume that a child would use it 4 hours/day, 350 days /year for 12 years.

Problem # 11 (6 marks)

a) What are the 3 key factors that influence the environmental change? (3 marks)

b) The population of a city is currently 1 million people. Using a constant annual growth rate, what is the percent increase in population after 10 years with an annual growth rate of 5 percent? (3 marks) $P = P_0 (1+r)^t$

BONUS (6 marks)

a) What is "bad ozone" and its source? (3 marks)

b) What is eutrophication and what is its cause? (3 marks)

Table 14.2 Standard default exposure factors for environmental risk assessments. These EPA guidelines are used for calculating reasonable maximum exposure at a contaminated site.

Land Use at or Near Site	Exposure Pathway	Daily Intake	Exposure Frequency (Days/Year)	Exposure Duration (Years)[a]	Body Weight (kg)
Residential and agricultural	Ingestion of potable water	2 liters	350	30	70
	Ingestion of soil and dust	200 mg (child) 100 mg (adult)	350	6 24	15 (child) 70 (adult)
	Inhalation of contaminants	20 m^3 (total) 15 m^3 (indoors)	350	30	70
Commercial/industrial	Ingestion of potable water	1 liter	250	25	70
	Ingestion of soil and dust	50 mg	250	25	70
	Inhalation of contaminants	20 m^3 per workday	250	25	70
Agricultural	Consumption of homegrown produce	42 g (fruit) 80 g (vegetables)	350	30	70
Recreational	Consumption of locally caught fish	54 g	350	30	70

[a] These values are only for noncarcinogenic chemicals. For carcinogens the value is 70 years.

Source: USEPA, 1991.

Table 14.3 Potency factor values for selected chemicals.

Substance	Oral PF $(mg/kg\text{-}da)^{-1}$	Inhaled PF $(mg/kg\text{-}da)^{-1}$
Metals and Inorganics		
Arsenic	1.5	50.0
Beryllium	4.3	8.4
Cadmium	—	6.3
Chromium VI	—	42
Organic Compounds		
Benzene	5.5×10^{-2}	2.9×10^{-2}
Benzol(a)pyrene (BaP)	7.3	3.10
Chloroform	6.1×10^{-3}	8.1×10^{-2}
1,4 Dioxane	1.1×10^{-2}	—
Formaldehyde	—	4.5×10^{-2}
Methylene chloride	7.5×10^{-3}	1.65×10^{-3}
Polychlorinated biphenyls (PCBs)	0.4–2.0	0.4–2.0
Tetrachloroethylene	5.2×10^{-2}	2.0×10^{-3}
Trichloroethylene (TCE)	1.1×10^{-2}	6.0×10^{-3}

Source: ORNL, 2000; USEPA, 1999.

Table 14.4 Reference dose values for selected chemicals.

Substance	Oral RfD (mg/kg-da)	Inhaled RfD (mg/kg-da)
Metals and Inorganics		
Ammonia	—	2.86×10^{-2}
Arsenic	3×10^{-4}	—
Beryllium	2×10^{-3}	5.7×10^{-6}
Cadmium	1.0×10^{-3} (diet)	6.1
	5.0×10^{-4} (water)	6.1
Chlorine	0.1	5.7×10^{-5}
Chromium VI	3×10^{-3}	2.86×10^{-5}
Hydrogen chloride	—	5.71×10^{-3}
Manganese	1.4×10^{-1} (diet)	1.43×10^{-5}
	4.60×10^{-2} (water)	1.43×10^{-5}
Mercury	—	8.57×10^{-5}
Selenium	5.0×10^{-3}	—
Zinc	3×10^{-1}	—
Organic Compounds		
Carbon disulfide	0.1	0.2
Chloroform	1×10^{-2}	—
Formaldehyde	0.2	—
n-Hexane	6.00×10^{-2}	5.71×10^{-2}
Methanol	5×10^{-1}	—
Methyl ethyl ketone	0.6	0.286
Methylene chloride	6.0×10^{-2}	0.857
Styrene	0.2	0.286
Tetrachloroethylene	1.0×10^{-2}	0.171
Toluene	0.2	0.114
Xylene	2.0	—

Source: ORNL, 2000; USEPA, 1999.